

Summary Report on the Department of Energy's Clean Cities 5-year Strategic Planning

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Solutions

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Report Overview

This report reflects stakeholder input to inform the U.S. Department of Energy (DOE) Clean Cities' strategic plan. The report focuses on comments made by stakeholders on key market opportunities for each alternative fuel and petroleum use reduction strategy. This report will be followed by a strategic plan that further refines the stakeholder input outlined here.

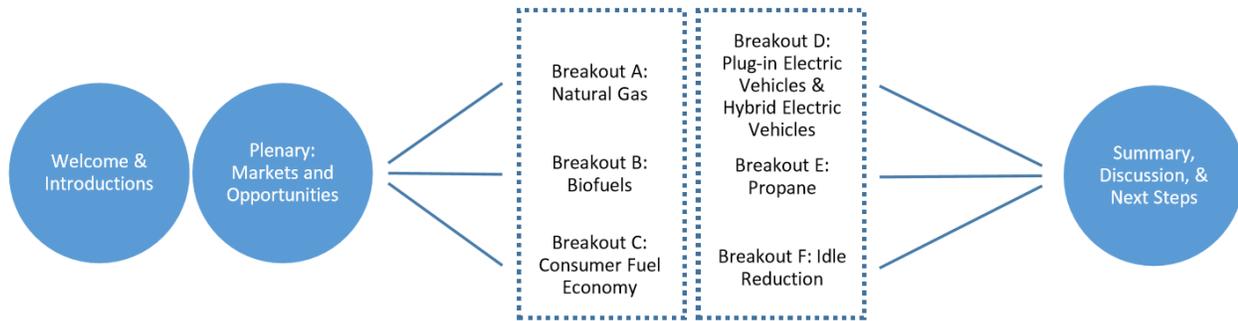
Clean Cities is a DOE program that advances the nation's economic, environmental, and energy security by supporting local actions to reduce petroleum use in the transportation sector. DOE Clean Cities has displaced nearly 7.5 billion gallons of petroleum since its inception in 1993. The program has nearly 100 coalitions across the country and works with nearly 14,000 stakeholders, including fleets, fuel suppliers, local governments, vehicle manufacturers, national laboratories, state and federal government agencies, and other organizations.

DOE hosted a public meeting in Washington, D.C., on February 25, 2015, to seek input from an array of stakeholders to inform DOE's Clean Cities program Five-Year Strategic Plan. Stakeholders provided feedback on six alternative fuel and petroleum use reduction strategies: natural gas, biofuels, consumer fuel economy, plug-in electric and hybrid-electric vehicles, propane, and idle reduction.

DOE national laboratory experts presented briefing papers to stakeholders on economic, behavioral, and technical issues. The authors also presented their ideas on prioritizing market opportunities. Neutral third-party facilitators led breakout sessions for each of the alternative fuels and petroleum use reduction strategies. For each market opportunity DOE Clean Cities received feedback about the potential payoff, the likelihood of success, and the potential impact by DOE Clean Cities and its coalitions.

Meeting Summary

Organizers outlined DOE Clean Cities' goals, progress toward those goals, and the state of the alternative fuel vehicle (AFV) market. Breakout group discussions focused on individual alternative fuel or petroleum use reduction strategies. Participants could attend up to two breakout sessions. Finally, organizers reconvened all attendees for a plenary session to present a meeting summary and the next steps the DOE Clean Cities Program staff would take to produce a five-year strategic plan.



The meeting consisted of sessions with all attendees, with smaller breakout groups hosted in between. The detailed meeting agenda is included in Appendix A. Participants selected among Breakout Groups A, B, and C first, followed by Breakout Groups D, E, and F, allowing attendees to participate in up to two out of the six breakout sessions before reconvening for the final plenary session.

Attendees were asked to consider not only which niches and fleet applications had the greatest market appeal or potential, but also to focus on those where the Clean Cities program and local coalitions could have the greatest potential impact/influence. In a number of sessions attendees remarked that Clean Cities help and assistance would be critical or even essential in helping to transform markets, such as school buses and paratransit. Further, it was noted that while some niches are known to be fantastic market opportunities for alternative fuels, such as transit buses and refuse trucks, the alternative fuel market is already strong in those areas and Clean Cities initiatives may no longer be as critical or essential for market introduction efforts. As a result, those opportunities may not have been called out as priorities in the session rankings. At the same time, attendees noted that Clean Cities technical and problem solving assistance for new vehicle technologies tends to grow in importance as larger numbers of vehicles are placed into service.



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Summary of Priority Recommendations

Attendees provided feedback on each proposed market opportunity during the day’s breakout sessions. They also identified some opportunities not covered by the national laboratory experts. The table below is a synthesis of the attendees’ priority opportunities for each alternative fuel or petroleum use reduction strategy. Detailed recommendations for actions by DOE Clean Cities and program focus areas are presented in the subsequent section of this report. An overview of the discussion for each technology or petroleum use reduction strategy is presented, followed by a summary of the top-priority opportunities.

Table 1: Market Opportunities Proposed by Experts and Breakout Group Priorities for each Alternative Fuel Type or Petroleum Use Reduction Strategy

Alternative Fuel / Petroleum Use Reduction Strategy	Market Opportunities proposed by experts in Briefing papers and presentations	Top-Rated Market Opportunities
Natural Gas (A)	<ul style="list-style-type: none"> Concrete Mixers Paratransit Vehicles Regional Haul Renewable Natural Gas—Landfills and Food Waste School Buses Utility Service Vehicles 	<ul style="list-style-type: none"> • Regional Haul* • Paratransit Vehicles
Biodiesel (B)	<ul style="list-style-type: none"> Ports Retail Stations Regional Haul School Buses Work Trucks 	<ul style="list-style-type: none"> • School Buses** • Ports
E85 (B)	<ul style="list-style-type: none"> General Consumer Local Government State Government 	<ul style="list-style-type: none"> • Local Government (Including Police) • General Consumer

Alternative Fuel / Petroleum Use Reduction Strategy	Market Opportunities proposed by experts in Briefing papers and presentations	Top-Rated Market Opportunities
Consumer Fuel Economy (C)	Consumer Access via Mobile Devices Consumer Uncertainty about Official Mile Per Gallon (MPG) Estimates Expanded Outreach Improving the Understanding of Advanced Automotive Technologies' Fuel Economy Periods of Low Gasoline Prices Used Vehicle Market	<ul style="list-style-type: none"> Expanded Education and Outreach Improving the Understanding of Advanced Automotive Technologies' Fuel Economy
Plug-in Electric Vehicles and Hybrid Electric Vehicles (D)	Cars, Trucks, and Buses in Dense Urban Areas Cold Climate States and Regions Major Locations of Passenger Car Hybrid Electric Vehicles Nationwide Major Metro Non-Attainment Areas New Metro Edge (Outer Suburban) Construction Workplace Charging Nationwide	<ul style="list-style-type: none"> Corridor DC Fast Charging Workplace Charging
Propane (E)	Delivery Vehicles Government Fleets Paratransit Vehicles School Buses	<ul style="list-style-type: none"> School Buses** Delivery Trucks
Idling Reduction (F)	Ambulance: Electrified Parking Space Bucket Truck: Workplace Hybrid Long-Haul Truck (North): Diesel Auxiliary Power Unit (APU) Long-Haul Truck (South): Electrified Parking Spaces Personal Vehicles: Turn the Engine Off Police Car: Battery APU School Buses: Heaters	<ul style="list-style-type: none"> Long Haul Trucks (Northern Routes) Long Haul Trucks (Southern Routes)

*Rated very highly compared to market opportunities for other alternative fuels and petroleum use reductions methods

**Presents a cross-cutting opportunity

Cross-Cutting Observations from Attendees

Attendees made several observations about specific fuels that could be applicable to other fuels, technologies, and niche markets. The following are example observations made by attendees that *could be* considered cross-cutting:

- Some alternative fuels may not be feasible in utility fleets because low annual miles traveled can reduce the return on investment and a utility may not be able to respond to an emergency because of limited fueling infrastructure.
- Local coalitions could inform first responders that the vehicles use alternative fuels.
- DOE Clean Cities could develop digital and social media campaigns that target the right consumers, providing information on alternative fuel products and programs.
- Coalitions could target Parent-Teacher Associations and school boards as valuable partners for promoting alternative fuel use in school buses for health purposes.
- Ports present an opportunity for Clean Cities coalitions to engage large, heavy-duty vehicle fleets that are based in a single location, where economies of scale could reduce the average cost of fueling infrastructure development.
- Clean Cities coalitions could familiarize consumers with advanced technologies through outreach events such as ride-and-drives. The coalitions could engage dealerships or companies to host these events.
- Local coalitions could give an incentive to dealers by creating an award that recommends DOE recognize dealers that successfully sell alternative fuel vehicles.
- Coalitions could highlight the opportunity for first responder fleets to reduce costs with alternative fuels.
- Clean Cities could create case studies and identify best practices for real-world alternative fuel fleets and share these case studies and best practices with interested fleet managers.
- Coalitions can assist fleet managers in implementing alternative fuel paratransit vehicle fleet projects.
- Coalitions can also work with airports to make alternative fuels an option in contract bids, particularly at the growing number of airports that have sustainability plans.
- Attendees emphasized the opportunity for Clean Cities coalitions to spread information about the potential cost savings that fleet operators could achieve through idle reduction and alternative fuel use.

Review of Breakout Group Discussions

Each of the breakout groups discussed opportunities to displace petroleum using each specific alternative fuel or petroleum use reduction strategy. Facilitators encouraged attendees to discuss barriers and opportunities. Participant feedback was organized into categories to provide insights into each opportunity's potential to reduce petroleum use, including:

- **Payoff:** The petroleum use displacement potential of advancing an alternative fuel or petroleum use reduction strategy.
- **Likelihood:** The likelihood of success in realizing the potential payoff.
- **Clean Cities' Impact:** The ability of DOE Clean Cities and local coalitions to have a significant impact on the overall deployment of this technology or strategy.
- **Overall Potential:** The aggregate potential of Payoff, Likelihood, and Clean Cities Impact.

Some similar opportunities and actions were recommended across several breakout groups. Breakout groups also identified opportunities in addition to those proposed by the national laboratory experts. Summaries in the following section offer insight into the reasoning for each breakout group's priority opportunities from Table 1.

Breakout Group A: Natural Gas

Attendees identified two natural gas vehicle opportunities from the laboratory briefing paper to be the most promising: regional haul and paratransit. Following a general summary of the breakout discussions are two boxes that summarize the most promising market opportunities according to participants. See Figure 1 for a breakdown of participants by affiliation.

Attendees emphasized the need for Clean Cities coalitions to help consumers and fleet operators understand the process of natural gas vehicle conversions and the performance and potential cost savings of natural gas vehicles. Attendees highlighted DOE Clean Cities' valuable tools and resources on the vehicle conversion process and the financial performance of using natural gas vehicles. They also highlighted the need for Clean Cities coalitions to distribute these materials locally, acting as technological resources and links to national laboratory experts. Across market opportunity types, attendees recommended developing and promoting case studies of successful natural gas fleet operations and promoting financial tools such as DOE's AFLEET Tool and VICE Model to help fleet operators gauge the return on investment of switching to natural gas.

Attendees noted that DOE Clean Cities could provide guidance on lowering the high upfront costs of converting fleets, infrastructure, and maintenance facilities to natural gas, which can make attracting investment difficult. They also suggested that DOE Clean Cities' guidance and technical assistance should be deployed to help troubleshoot issues and increase the likelihood of a project's success. Attendees recommended that Clean Cities coalitions offer additional training across opportunity types for technicians who interact with natural gas vehicle infrastructure or maintenance facilities, since many fleets are still unfamiliar with the technology.

Attendees suggested that Clean Cities coalitions could also collaborate with natural gas utilities. Utilities that adopt and promote the use of natural gas vehicles can improve consumer awareness and comfort with the technology. In addition, natural gas utilities are in a unique position to address concerns about pipeline transmission of renewable natural gas, a fuel that is emerging because financial incentives are included in the Environmental Protection Agency's (EPA) Renewable Fuel Standard, which runs through 2022. However, attendees noted that natural gas vehicles may not be feasible in utility fleets for two reasons. First, low annual miles traveled can reduce the return on investment. Second, a utility may not be able to respond to an emergency because of limited fueling infrastructure.

Natural Gas Top Market Opportunity: Regional Haul

Regional haul refers to freight trucks that typically travel 200 miles per day and return to the same location each night. Collectively, 800,000 regional haul trucks annually drive 50 billion miles and consume 9 billion gallons of diesel. Participant feedback indicated that this market opportunity has a high potential to reduce petroleum compared to all other technologies and petroleum use reduction methods considered. Regional haul was also thought to have the highest overall potential of any natural gas opportunity, with a high likelihood of success and a strong potential impact from DOE Clean Cities and local coalitions.

DOE Clean Cities and coalitions could make an impact on the regional haul market by informing fleet operators about the program's financial tools, notably AFLEET and VICE, and by collaborating at the local and national level with industry leaders to establish cost-effective options for constructing fueling stations. In addition, DOE Clean Cities could develop and promote case studies of successful natural gas regional haul fleets to share solutions to common barriers such as access to public fueling infrastructure and high upfront vehicle costs.

Natural Gas Top Market Opportunity: Paratransit Vehicles

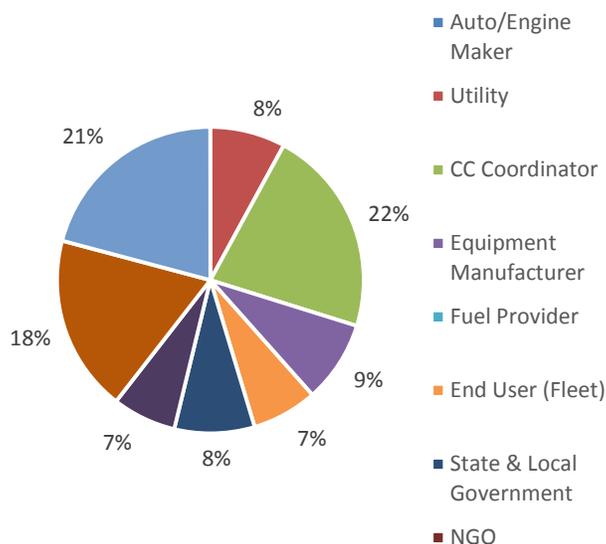
Paratransit vehicles provide on-demand transit service, often provide transport for senior citizens and people with disabilities, and can operate as a shuttle service. Collectively, 690,000 paratransit vehicles annually drive 1.4 billion miles and use 190 million gallons of gasoline equivalent. Attendees considered this market opportunity to have consistently strong potential across the feedback categories (payoff, likelihood, and DOE Clean Cities and coalitions' impact), suggesting that this is a versatile opportunity.

Paratransit vehicles typically operate as part of a regional fleet, which allows Clean Cities coalitions to engage with a few local fleet operators that manage large numbers of vehicles. Clean Cities coalitions could facilitate the shared use of regional fueling centers among paratransit and other fleets, which would lower overall infrastructure costs for each fleet participant. School bus fleets, for example, could refuel overnight, leaving the stations open for paratransit fleet use during the day. In addition, current commercially available natural gas vehicles do not appear to meet the needs of paratransit fleets. DOE Clean Cities and coalitions could collect and share these needs with industry stakeholders, including original equipment manufacturers.

Attendees expressed several additional notable suggestions, including:

- DOE could help create tools to help coalitions approach cement mixer operators about conversion opportunities and how natural gas could improve fleet performance;
- DOE could work with industry and fleets to improve their vehicle branding to help promote AFVs and to inform first responders that the vehicle uses natural gas;
- In states where organic waste must be recycled, Clean Cities coalitions could connect biogas generators and renewable natural gas users.

Though some attendees considered the overall petroleum use reduction potential of food and beverage delivery trucks as relatively low, others pointed out that the vehicles' high annual miles traveled could produce a strong return on investment when petroleum prices are high. Attendees noted this may also be true of linen delivery trucks. Coalitions could identify high-mileage fleet operators and share DOE financial tools to determine if converting to natural gas would be profitable.

Figure 1: Natural Gas Participants by Affiliation (64 Attendees)

This figure shows the self-identified affiliation of each participant in the natural gas breakout group.

Breakout Group B: Biofuels

As this breakout group discussed two distinct fuel types, biodiesel and E85, attendees identified two promising uses for each fuel type. For biodiesel, the most promising opportunities were school buses and ports. For E85, the most promising opportunities were the general consumer and local government. A general summary of the breakout discussions for each fuel type is followed by two boxes that summarize the most promising market opportunities, according to participants (see Figure 2 for a breakdown of participants by affiliation). In addition, attendees noted two cross-cutting opportunities for biofuels:

- DOE Clean Cities and automakers could coordinate efforts to educate consumers on the benefits of increased biofuel use. Greater consumer awareness of biofuels would enable coalitions to expand their outreach activities to an informed population.
- DOE Clean Cities could develop digital and social media campaigns that target the right consumers, providing information on biofuel products and programs. This could help to educate consumers about the basics of biofuels and biofuel performance compared to diesel or gasoline vehicles.

DOE Clean Cities could share the successful strategies of current biodiesel fleet operators and provide tools or information about payback periods for owning and operating biodiesel equipment. The success stories could also help to dispel outdated myths about biodiesel blends with 20 percent (B20) or lower performing poorly, particularly in extreme temperatures, compared to petroleum diesel vehicles. A successful collaboration between DOE's Vehicle Technology Office and the National Biodiesel Board addressed many issues related to fuel quality resulting in all original engine manufacturers supporting B5 (5 percent biodiesel) and many supporting B20.¹ Training sessions with mechanics and fleet operators conducted by coalitions, either in-person or online, could improve outdated and erroneous perceptions of biodiesel performance.

¹ U.S. Department of Energy. 2015. Vehicle Technologies Office: Improving Biodiesel and Other Fuels' Quality. Accessed June 29, 2015. <http://energy.gov/eere/vehicles/vehicle-technologies-office-improving-biodiesel-and-other-fuels-quality-0>.

DOE Clean Cities could engage local coalitions and provide tools to identify likely fleet partners. DOE Clean Cities could encourage coalitions to work with local fleet chapters and associations to assess local vehicle markets and identify fleets for biodiesel conversion. Potential candidates for conversion include small fleets that can use existing biodiesel fueling infrastructure or share new fueling infrastructure, light-duty fleets that could convert to biodiesel, and markets where biodiesel has a price advantage over gasoline or diesel. Some fleets in rural communities may be inclined to purchase biodiesel from retail stations, particularly when a price advantage exists. Clean Cities coalitions could explore retailer partnerships to consolidate biodiesel demand in support of fuel suppliers.

Biodiesel Top Market Opportunity: School Buses

Approximately 675,000 school buses in the United States collectively drive an annual total of 8.1 billion miles and use 1.3 billion gallons of gasoline equivalent per year. The most common school buses are Class 6-7, weighing between 19,501 and 33,000 pounds. Attendees considered that school buses had the greatest overall potential of any biodiesel market opportunity. As locally based fixtures in communities throughout the United States, Clean Cities coalitions can have a significant impact on local decision-making processes regarding the increased use of alternative fuels in school buses.

Clean Cities coalitions could promote biodiesel to school districts because biodiesel blends of 20 percent (B20) or lower do not require modifications to vehicles or infrastructure. Individual buses may not use much fuel annually, though some of the country's largest bus fleets annually travel over 15,000 miles per vehicle. Coalitions that engage with older school bus fleets could yield greater emissions reductions for greenhouse gases and criteria pollutants, minimizing contributions to climate change and improving local air quality. Coalitions could target Parent-Teacher Associations and school boards as valuable partners for promoting biodiesel use in school buses for health purposes.

Biodiesel Top Market Opportunity: Ports

Breakout group attendees considered vehicles serving ports as part of a broader off-road category, which includes terminal trucks, marine rail, and mining trucks. These ports, mines, or transportation hubs may be located along the coasts or inland. Attendees considered the overall potential of this market opportunity to be nearly as high as school buses, with an equally high payoff potential and an even stronger likelihood of adoption. The potential for DOE Clean Cities and local coalitions to make an impact with biodiesel in this area was considered to be higher than any other biodiesel market opportunity except for school buses. Each of the four categories within this market opportunity was considered to have a greater potential than any single category of the next-highest opportunity, work trucks.

Ports present an opportunity to Clean Cities coalitions to engage large, heavy-duty vehicle fleets that are based in a single location, where economies of scale would reduce the average cost of fueling infrastructure deployment. For example, a local coalition in Virginia could engage with two port fleet operators and have the same petroleum use reduction impact as engaging with 64 school districts. The limited locations of ports and a lack of outside funding opportunities for ports and other off-road projects could restrict the impact DOE Clean Cities could make. However, the large and diverse number of vehicles that ports use can benefit from the versatility of biodiesel and could make for an attractive petroleum use reduction opportunity.

Clean Cities coalitions could engage with specific sub-sets of ports, such as mines and transportation hubs. The use of cleaner biodiesel could draw the support of unions interested in worker health and safety. Coalitions could help arrange contracts to purchase or estimate the cost to purchase a certain amount of biodiesel, similar to a contract that the city of Fort Worth, Texas executed with Mansfield Oil in April 2015.¹

¹ City of Fort Worth. 2015. "Amendment to Existing Contract: 14-0121, Motor Fuels and Aviation Fuels, Between the City of Fort Worth and Mansfield Oil Companies." National IPA. April 10. Accessed June 29, 2015. http://www.nationalipa.org/PDF-solicitdocs/Motor%20Fuels%20and%20Aviation%20Fuels/Contract_Mansfield.pdf.

Attendees also made two notable suggestions:

- Local coalitions could approach their regional and local mass transit operators with information on biodiesel performance and opportunities, particularly since new vehicle purchases would not be necessary to incorporate biodiesel blends at a time when transit agencies' vehicle procurement budgets may be low.
- Utilities could be strong partners, particularly given their obligation under the Energy Policy Act of 2005 (EPAct) to reduce their vehicle fleet emissions, which may be accomplished through increased biodiesel use. Clean Cities coordinators could help to connect utilities with biodiesel producers.

Ethanol (E85)

E85, a fuel comprised of 85 percent ethanol and 15 percent gasoline, may be an attractive alternative fuel because it can be used in over 16 million vehicles on the roads—flex fuel vehicles (FFVs) represent the largest segment of AFVs on the road today. Despite the relatively large market for FFVs, most consumers do not know what E85 is, whether it can be used in their existing vehicles, or where to find it.

Attendees recommended that DOE Clean Cities help educate consumers about how to save money and reduce emissions with the FFVs they may already own. In particular, a multimedia message aimed at consumers likely to have an FFV or purchase one could encourage greater E85 use. According to attendees, education and outreach activities should clarify issues such as the “food versus fuel debate” and the potential to reduce greenhouse gas emissions with increased use of E85.

Attendees also suggested that Clean Cities coalitions could work with government agencies at the local utility and state levels to help deploy stations by encouraging new state or regional grant opportunities for deployment initiatives or demonstration projects. They could also encourage new state tax credits for E85 sales. Attendees noted that coalitions could also highlight the value of deploying E85 fueling stations to help local utility and state fleets comply with EPAct, which could reduce the occurrence of fleets purchasing FFVs without using E85. To identify the right fueling locations, coalitions could help assess the best E85 markets to inform investors and governments about potential areas with consolidated demand.

DOE Clean Cities and coalitions could partner with several organizations to bridge information and policy gaps, attendees suggested. For instance, working with statewide organizations, including broadcasters, could help improve customer awareness. Similarly, coalitions could encourage ethanol producers to promote E85's market potential, rather than focusing on encouraging biofuel blends of 15 percent (E15) for compliance with the federal Renewable Fuel Standard.

E85 Top Market Opportunity: General Consumer

There were 16.4 million registered FFVs on U.S. roads at the end of 2013, accounting for 6.6 percent of all vehicle registrations and 18.6 percent of all new vehicle registrations. The majority of FFVs, which can run on ethanol blends up to 85 percent, are owned by the general public rather than by business fleets. Currently, however, very few FFVs on the road use E85. Attendees considered the general consumer market opportunity to have the greatest overall potential of any E85 opportunity. This market opportunity also has the potential for a high payoff in petroleum use reduction, though attendees estimated a low likelihood for reducing petroleum use and low potential for DOE Clean Cities program and local coalitions to make an impact.

Attendees proposed that DOE Clean Cities and coalitions could act as a resource to provide fueling retailers with technical and market analysis on E85, performance capabilities (E85 is an inexpensive high-octane fuel), and installation requirements. Coalitions could also work with fueling retailers to increase their awareness about the potential for new revenue opportunities by offering E85. Participants noted that additional publicly available fueling stations are vital to increasing public use of E85.

In addition, federal light-duty vehicles standards require EPA to estimate the amount of alternative fuels being used in FFVs beginning with model year 2016. DOE Clean Cities could work with original equipment manufacturers to improve their approaches to educate the FFV consumer base and encourage greater E85 consumption.

E85 Top Market Opportunity: Local Government

Local governments could expand E85 use by incorporating more FFVs into their fleets, using more E85 in their FFVs, and enacting incentives to promote E85 use. Attendees considered this market opportunity to have a moderate overall potential to reduce petroleum use, and noted that Clean Cities coalitions could capitalize on their familiarity with local governments to make an impact. The potential payoff and likelihood of success from engaging with local governments were not estimated to be very high. However, the biofuels breakout group saw E85 use in police cars as a particularly strong opportunity in the context of local government engagement. Some attendees estimated the likelihood of success in realizing the potential benefits as very high, with strong estimates for overall potential and for DOE Clean Cities' and coalitions' ability to make an impact.

Police cars make up a large percentage of local governments' FFV fleets. The large number of police cars in local fleets, combined with the tendency of police cars to idle for long periods, means they use a lot of petroleum. Police vehicles may not be able to reduce idling due to safety and reliability concerns (see *Breakout Group F: Idle Reduction* for more information, but coalitions could make the case that increased E85 use could reduce greenhouse gas emissions compared to gasoline. Participants also noted that coalitions should emphasize the high performance that high-octane E85 could deliver in police cars.

Clean Cities coalitions could also encourage local governments to take steps to accelerate the deployment of E85 fueling stations. The city of Chicago, for example, has an AFV program that has deployed E85 fueling stations and has prioritized E85 use in its FFV fleet vehicles.¹ Partnering with local governments could also help ease permitting requirements for the installation of E85 fueling infrastructure. Because local fleets are more concentrated in one area than state or federal fleets, fueling infrastructure can be shared among local agencies, which would spread costs over a greater number of fleets.

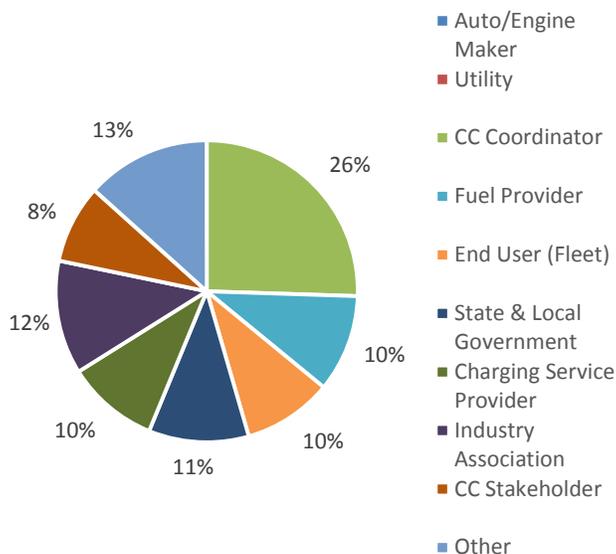
Attendees also expressed notable considerations, including:

- Clean Cities coalitions may choose to avoid focusing on increasing the use of E85 in federal fleets, since federal fleets are too widely dispersed to use dedicated infrastructure and very little funding has been made available for E85 infrastructure that targets the federal fleet.

¹ U.S. Department of Energy. 2014. City of Chicago Program Encourages Petroleum Displacement and Collaboration Between Departments. May 16. Accessed June 29, 2015. <http://www.afdc.energy.gov/case/1844>.

- Coalitions should identify and promote funding sources for fueling infrastructure installation, since fueling stations are crucial to expanding E85 use. For example, Illinois had a rebate of up to \$450 per year for up to three years for each FFV that used E85 at least half the time and offers grants for E85 infrastructure installation.
- Coalitions could connect retailers and fuel producers to help lower costs to retailers and enable them to offer more competitive pricing.

Figure 2: Biofuels Participants by Affiliation (22 Attendees)



This figure shows the self-identified affiliation of each participant in the biofuels breakout group.

Breakout Group C: Consumer Fuel Economy

Attendees identified two strategies to improve consumer fuel economy as the most promising: expanded education and outreach, along with improving the understanding of advanced automotive technologies’ fuel economy. Following a general summary of the breakout discussions are two boxes that summarize the most promising market opportunities according to participants. See Figure 3 for a breakdown of participants by affiliation.

Attendees noted that many car purchase decisions are driven by rational considerations, such as fuel use and total cost of ownership, but vehicle purchases can still be based on emotion. Regardless, DOE Clean Cities should continue to conduct outreach in an informative rather than promotional manner, because the organization functions best as a provider of vehicle information and fuel-saving driving techniques.

Attendees also suggested that the DOE Clean Cities program promote a diverse use of communications technologies to allow consumers to access better information and improve vehicle fuel economy. The use of mixed media strategies, including mobile applications (apps) and social media, as well as more traditional media, would expand the reach of the Fuel Economy Information (FEI) Project, which is DOE’s principal outreach channel for information on vehicle fuel economy. Part of this outreach strategy could include promoting applications and devices that relay real-time fuel use, which can improve vehicle fuel economy through better driving techniques.

Two notable cross-cutting suggestions from participants involved both of the two highest rated opportunities: expanded education and outreach, and improving the understanding of advanced automotive technologies’ fuel

economy. First, many vehicles are equipped with real-time driving displays that enable drivers to gauge their fuel economy. Research from the National Association of Fleet Administrators, however, has found that many drivers may not know how best to maximize their vehicle's fuel economy, even with the aid of the displays. DOE Clean Cities and coalitions could engage various audiences to train drivers on the optimal use of real-time fuel economy displays and to share the driving tips found on the fueleconomy.gov website. Second, Clean Cities coalitions could familiarize consumers with advanced technologies through outreach events such as ride-and-drives. The coalitions could engage companies to host these events.

Participants also noted that DOE Clean Cities and coalitions often focus their outreach and education efforts on fleets, but that outreach efforts to general consumers may require different techniques.

Consumer Fuel Economy Top Market Opportunity: Expanded Education and Outreach

The DOE Clean Cities FEI Project distributes the Fuel Economy Guide, hosts the fueleconomy.gov website, and engages in multiple partnerships with national associations to promote fuel economy information and techniques. Attendees considered expanded education and outreach to have the greatest overall potential to reduce petroleum use among all of the identified light-duty vehicle fuel economy market opportunities. Education and outreach were also considered to have the greatest potential for the Clean Cities program's efforts to deliver a significant impact.

DOE Clean Cities could help conduct a public service campaign that features fuel-saving driving techniques and reaches a large and diverse audience. Participants noted that education and outreach could be used to motivate drivers to reduce fuel consumption, which also reduces the total cost of vehicle ownership. DOE Clean Cities could partner with automakers, advertising experts, and national laboratories to convey the cost-saving message. DOE's collaboration with these partners could construct a unified, consistent message on the potential to reduce petroleum use through improved fuel economy. Partnerships with advertising experts could also create a unique message that reinforces the fuel economy importance, as the "Click it or Ticket" campaign accomplished with seat belt use.

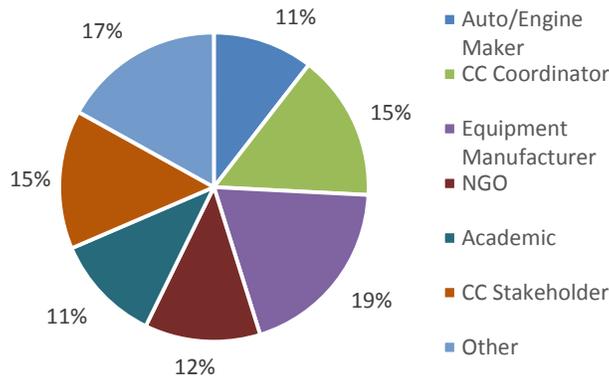
Attendees suggested that DOE Clean Cities could also research how consumers consider fuel economy in their purchase decisions to help DOE choose the most effective methods of education and outreach. The attendees noted that even with the best information, consumers do not always choose the most fuel-efficient vehicles. Effective communication of payback periods could be important, as automakers have determined that consumers typically expect a return on investment from improved vehicle fuel economy within 1-3 years of purchase.

Consumer Fuel Economy Top Market Opportunity: Improving the Understanding of Advanced Automotive Technologies' Fuel Economy

New vehicle technologies can improve fuel economy in light-duty vehicles, but can introduce complications in how fuel economy is measured. Hybrid electric vehicles, plug-in electric vehicles, and hydrogen fuel cell vehicles all use different techniques to measure fuel economy and fuel cost savings. Attendees estimated the overall potential of this market opportunity to be nearly as high as the potential of expanded education and outreach, though with a slightly lower perceived ability for DOE Clean Cities and local coalitions to make an impact.

The FEI Project could offer consumers concise fuel economy measurements for advanced auto technologies that would clarify vehicle fuel economy comparisons. DOE Clean Cities could improve the fuel economy estimates of advanced automotive technologies by reconciling battery life estimates for hybrid electric and plug-in electric vehicles, and by evaluating the relatively unknown performance of hydrogen fuel cell vehicles. Clean Cities coalitions could improve their local impacts by engaging directly with automakers to promote advanced automotive technologies, either at dealerships or at outreach events, such as ride-and-drive events and engagements that encourage eco-driving.

Figure 3: Consumer Fuel Economy Participants by Affiliation (16 Attendees)



This figure shows the self-identified affiliation of each participant in the consumer fuel economy breakout group.

Breakout Group D: Plug-In Electric Vehicles and Hybrid Electric Vehicles

Attendees identified two promising ways potentially to increase the use of these vehicles: corridor DC fast charging and workplace charging. Following a general summary of the breakout discussions are two boxes that summarize the most promising market opportunities according to participants. See Figure 4 for a breakdown of participants by affiliation.

Participants in this breakout group suggested the most new opportunities, indicating that electric drive technology has the potential for numerous and diverse strategies to reduce petroleum consumption.

The need to address the confusion caused by various electric drive terminologies was raised by several participants. DOE Clean Cities could work with the electric vehicle industry and its stakeholders to clarify performance differences between plug-in hybrid electric vehicles (PHEVs) and all-electric vehicles (AEVs) and the functional difference between a hybrid electric vehicle and a PHEV. They could also clear up confusion that the term battery electric vehicle creates, since all vehicles have batteries. In addition, participants noted that the public needs to know PHEVs do not have range limitations since they have on-board gasoline engines.

Attendees recommended that Clean Cities coalitions continue to seek opportunities to help auto dealers educate and conduct outreach to fleets and the public. Coalitions can inform dealers about PEV incentives and relevant electricity rates, such as renewable-specific rates, PEV-specific rates, and time-of-use rates. Even in areas of high PEV demand, coalitions may need to proactively engage with auto dealers on PEV education. Local coalitions could give an incentive to dealers by creating an award that recommends DOE recognize dealers that successfully sell PEVs.

DOE Clean Cities can also play an important part in creating messaging around PEVs, according to participants. DOE can help create broad messaging that is fun, concise, and educational. DOE Clean Cities could engage with innovative transportation companies, such as Uber and Lyft, to help them promote PEVs through fleet deployment and online advertising techniques. Although modern systems, such as mobile apps that locate charging stations, are important, many drivers still navigate by following road signs. DOE Clean Cities and coalitions could work with U.S. Department of Transportation and state transportation departments to deploy standard PEV wayfinding signage to increase consumer awareness and access to charging.

Plug-In Electric Vehicles and Hybrid Electric Vehicles Top Market Opportunity: Corridor DC Fast Charging

Attendees considered corridor development of DC fast charging to be the greatest near-term market opportunity for DOE Clean Cities to consider supporting. DC fast charging stations typically supply vehicles with about 50 kilowatts of electricity, enabling most all-electric vehicles available today to reach 80 percent of their battery capacity in less than 30 minutes. Corridor DC fast charging was not highlighted as a market opportunity by Argonne National Laboratory, but attendees considered it to have the highest overall potential of any electric drive opportunity. Much of the potential that this market opportunity provides comes from respondents' high estimation of the payoff potential that corridor DC fast charging could eventually provide (particularly with longer range battery electric vehicles on the horizon).

Attendees said DC fast charging stations will likely be necessary to expand the travel range for upcoming, second generation all-electric vehicles (e.g., Chevy Bolt). They suggested Clean Cities coalitions could help deploy DC fast charging corridors by focusing on forming local partnerships and identifying future DC fast charging locations that support the two main connector standards, the Society of Automotive Engineers (SAE) Combo and CHAdeMO.

Attendees detailed that communities' siting analyses, some developed during a 2012 round of Clean Cities PEV readiness grants, should consider future vehicle performance, the risk of stranded assets, and station visibility. Siting fast chargers along travel corridors in a way that enhances their visibility helps familiarize the public with PEV charging technology, according to attendees. Local Clean Cities coalitions' siting analyses could also help reduce fragmented regional DC fast charging corridors, transforming local charging corridors into regional charging corridors, and could reduce the incidence of stranded assets.

As a cross-cutting market opportunity, several attendees from other breakout groups suggested that coalitions facilitate the co-locating of fueling stations for E85, compressed natural gas (CNG), hydrogen, and electricity. For example, with the support of local coalitions, the Charge Ahead Colorado program provides funding for co-located CNG and PEV charging infrastructure.

Plug-In Electric Vehicles and Hybrid Electric Vehicles Top Market Opportunity: Workplace Charging

Workplace charging is the second most common type of charging, after residential charging, and is much more prevalent than public charging. According to the 2009 National Household Travel Survey, almost 90 percent of workers commute via a light-duty vehicle or van. The distance to work for the majority of these commuters is within the battery ranges of most plug-in hybrid and all-electric vehicles.¹ Though workplace charging could greatly improve public and private charging access, and could expand PEV drivers' daily electric travel ranges, attendees considered this market opportunity to have a moderate potential for each category (payoff, likelihood, Clean Cities impact, and overall).

The DOE Workplace Charging Challenge, which leverages Clean Cities' resources, is actively educating stakeholders by sharing success stories and other information with employers that are considering installing workplace charging. Attendees expressed that these activities should continue to be a DOE focus, but suggested that DOE Clean Cities could provide more technical assistance to companies that want to pursue workplace charging. DOE Clean Cities and local coalitions could help employers determine what types of charging stations and networks would best serve their employees' needs, for example. Participants also suggested coalitions could play a more active role in pursuing partners for the challenge.

Attendees noted that being inclusive is important for workplace initiatives, including those on university campuses and schools. By making these stations accessible to fleet operators, other employees, and students, the equipment could provide a way for these employers to educate and promote PEVs.

DOE Clean Cities could also help companies learn the best methods for approaching employees to gauge interest in a workplace charging initiative. An example of a success story is Coca-Cola, which installed 75 charging stations and now has 150 Nissan Leafs that charge on-site. DOE Clean Cities could similarly engage CEOs of large companies, state legislators, and governors to address workplace charging with their organizations, and coalitions could contact local governments. For instance, the South Florida Regional Planning Council, a Clean Cities coalition, has worked with Broward County, which has joined the Workplace Charging Challenge. Attendees also suggested that local and regional chambers of commerce could also be valuable partners for reaching businesses interested in workplace charging.

Participants also noted that Clean Cities coalitions can ease the implementation of workplace charging initiatives. Coalitions can work to advance DOE Workplace Charging Challenge goals, such as bringing together regional employers to share best practices and tailor the program based on a region's or company's needs. Coalitions could work with employers to assess the travel needs of employees and to create a database of employees who need charging, which could be linked to a system that updates employees on newly available local charging stations.

Attendees also made several notable observations, including:

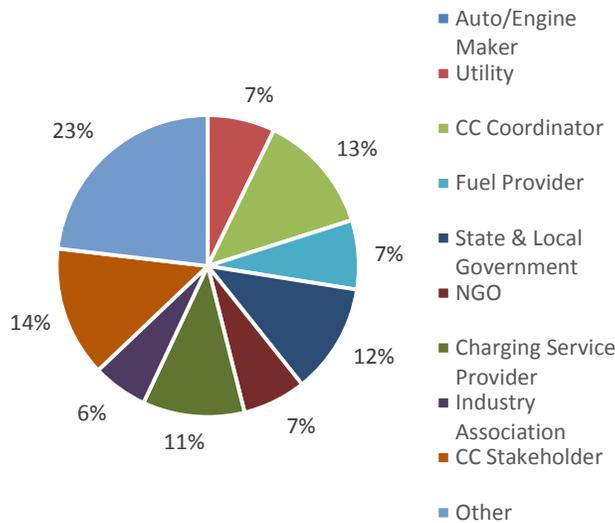
- DOE Clean Cities should not treat PEVs as a paradigm shift in transportation, but should consider them a new technology that can efficiently meet consumer needs.
- Promoting public Level 1 charging can expand access to a large segment of the population while avoiding electricity service charges, wiring and zoning issues, and increasing the use of locally-generated renewable energy.
- Clean Cities coalitions could work with local governments and utilities to develop incentives that encourage renewable energy connections to PEV charging, such as solar charging ports. For instance, a Minnesota utility guarantees PEV drivers that it will reserve wind power equal to the load of registered PEVs.

¹ Federal Highway Administration. 2010. National Household Travel Survey. Accessed June 29, 2015. <http://nhts.ornl.gov>.

- DOE Clean Cities could target PEV deployment activities in areas of non-attainment with the Clean Air Act. Coalitions in non-attainment areas could also connect to local agencies responsible for reducing the region’s criteria pollutant emissions.
- Local coalitions could connect first responders and workplace managers to training programs on PEV safety procedures.
- DOE Clean Cities could work with national laboratories to produce case studies on fleet performance in cold weather, innovative financing methods for PEVs and charging infrastructure, and the local economic benefits of PEV deployment.

In areas with new commercial and residential developments, coalitions could work with local government and developers to make buildings and communities PEV-ready through updated zoning ordinances and building codes.

Figure 4: Electric Drive Participants by Affiliation (43 Attendees)



This figure shows the self-identified affiliation of each participant in the electric drive breakout group.

Breakout Group E: Propane

Attendees identified two uses of propane from the laboratory briefing paper to be the most promising: school buses and delivery vehicles. Following a general summary of the breakout discussions are two boxes that summarize the most promising market opportunities according to participants. See Figure 5 for a breakdown of participants by affiliation.

Recommendations for DOE Clean Cities and coalitions to partner with knowledgeable industry groups cut across propane vehicle market opportunities. In particular, attendees recommended DOE Clean Cities and coalitions partner with the Propane Education and Research Council (PERC) and the National Propane Gas Association (NPGA) for education efforts, training, and technical expertise.

Attendees suggested three activities that DOE Clean Cities and coalitions could undertake in collaboration with propane technical and funding organizations:

1. Coalitions could train technicians and first responders on propane vehicle properties and safety measures. Propane industry groups offer free first responder training involving propane. DOE Clean Cities could promote this training to encourage safety and increase the familiarity with propane vehicles.
2. DOE Clean Cities could create case studies and identify best practices for real-world propane fleets categorized by vehicle type (e.g. vans, trucks, buses) and share these case studies and best practices with interested fleet managers.
3. DOE Clean Cities could work with propane equipment manufacturers to address fueling nozzle and safety procedure standardization issues.

Clean Cities coalitions could also assist fleets with the deployment of propane-powered paratransit vehicles. Although attendees did not consider paratransit vehicles to be a top priority, they considered these vehicles to have strong overall potential to reduce petroleum use. Coalitions could assist fleet managers in implementing paratransit vehicle fleet projects, helping them understand potential cost savings and emissions reductions. According to participants, coalitions could also help fleets identify public funding sources that may be available to lower the cost of paratransit fleet conversions to alternative fuels. For example, the Colorado Department of Transportation, the Greater Hartford Transit District, and the City of El Paso provide funding for alternative fuel paratransit conversions.¹

Participants noted that DOE Clean Cities and coalitions could help deploy propane-powered paratransit vehicles by helping local fleet operators identify the best propane conversion kits that are certified and meet safety requirements. Coalitions could connect interested fleet operators with local, certified, and reliable installers that can produce EPA certificates of compliance.

Attendees also offered several suggestions for DOE Clean Cities and coalitions to help deploy propane in airport shuttles and taxis, which may have a strong potential to reduce petroleum use because of these vehicles' high annual mileage and long idle times. Coalitions can help facilities' decision makers navigate local regulatory bureaucracies since they are fuel-neutral, independent parties. Coalitions can also work with airports to make propane a fuel option in contract bids, particularly at the growing number of airports that have sustainability plans, such as Dallas-Fort Worth and Denver. Attendees suggested that sharing case studies of successful propane airport shuttle fleet projects with sustainability officers and other decision makers will help increase the likelihood of expanding similar projects to new airports.

Though participants did not consider propane use in first responder vehicles to have high potential in any category, it was noted that first responder vehicles idle extensively. Coalitions could highlight the opportunity for first responder fleets to reduce costs with inexpensive propane.

¹ Federal Transit Administration. 2015. Fiscal Year 2012 Clean Fuels Grants Project Selections. Accessed June 29, 2015. http://www.fta.dot.gov/grants_14836.html.

Propane Top Market Opportunity: School Buses

Of the 675,000 school buses on U.S. roads, approximately 2 percent of those vehicles are fueled by propane. Some states and municipalities offer incentives for the use of propane in school buses, and school bus manufacturers offer a range of propane-fueled models. School buses were considered to have the highest overall potential of any opportunity among all propane vehicles for Clean Cities coalitions to have an impact.

Attendees suggested that coalitions could help schools identify cost savings opportunities through the greater use of propane. Many schools already have large on-site propane storage tanks for heating, with some tanks holding up to 30,000 gallons. Using that propane storage infrastructure for transportation could offset the approximately \$6,000 incremental cost of propane buses and could provide emissions benefits—an important factor when transporting children. In addition, attendees noted that coalitions could work with schools to deploy onboard propane-fueled auxiliary heaters, which would reduce diesel bus emissions and fuel consumption while idling. This cost-saving technique is particularly pertinent during cold weather conditions, since the auxiliary heater can warm the powered-off bus engine and heat the bus interior.

As established, well-connected regional resources, Clean Cities coalitions can provide information on the cost of vehicle conversions for school bus fleet managers, according to participants. DOE Clean Cities and local coalitions could serve as resources to share propane performance, prices, and availability. Attendees also suggested that coalitions could connect school districts interested in alternative fuel buses with propane-fueled bus manufacturers, who could provide an estimated return on investment. In some cases, coalitions could help fleet managers conduct assessments with DOE cost analysis tools.

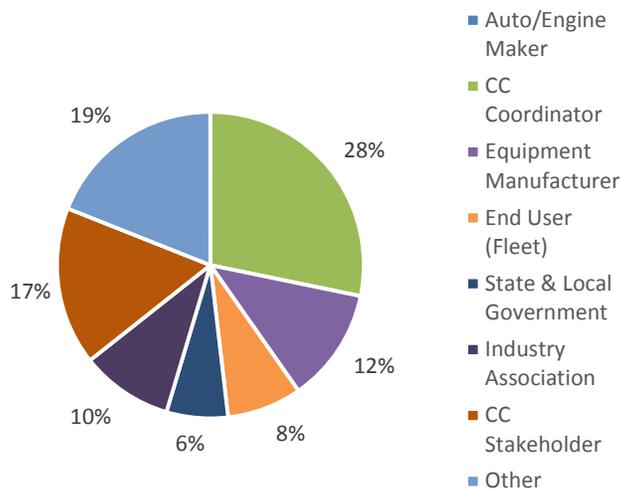
Attendees also proposed that Clean Cities coalitions could share the benefits of using propane by leveraging the knowledge of fleets with existing experience. Coalitions could share case studies that show payback and emissions benefits for conversion projects. They could also connect interested school bus fleets with managers of successful propane school bus fleets, who could provide real-world data. Lastly, attendees suggested that coalitions could connect interested fleets with state pupil transportation associations or the National Clean Fleets Partnership.

Propane Top Market Opportunity: Delivery Vehicles

In 2014, the United Parcel Service incorporated 1,000 propane trucks into its delivery fleets in Oklahoma and Louisiana. Other companies, such as Schwan's, have used propane trucks for deliveries over many years. Propane use in box trucks and step-vans for deliveries could increase propane use among these types of vehicles for purposes other than deliveries. Attendees considered this market opportunity to have a high overall potential, nearly as high as School Buses' overall potential. Payoff and likelihood potential were estimated as particularly strong, though the potential for the Clean Cities program and coalitions to make an impact on this market opportunity was considered to be slightly more moderate.

Participants recommended that Clean Cities coalitions could connect propane suppliers to interested fleets to help estimate cost savings through propane use. They noted that fleet managers may pay less than standard retail price for propane because they can receive discounts through long-term contracts with propane suppliers. Participants also noted that propane fueling stations often cost relatively less to install and may be provided at no up-front cost with a long-term contract. Coalitions could also highlight the environmental benefits of converting to propane, according to participants. Delivery trucks and vans are high-use vehicles that have a large potential to reduce emissions.

FIGURE 5: Propane Participants by Affiliation (32 Attendees)



This figure shows the self-identified affiliation of each participant in the propane breakout group.

Breakout Group F: Idle Reduction

Attendees identified two strategies to reduce idling: diesel auxiliary power units (APUs) for northern long haul truck routes and electrified parking spaces for southern long haul truck routes. Following a general summary of the breakout discussions is a box that summarizes the two most promising market opportunities according to participants. See Figure 6 for a breakdown of participants by affiliation.

Of all the categories related to idle reduction opportunities, attendees considered Battery APUs for police cars to have the highest potential payoff. However, the likelihood of reducing police car idling was estimated to be quite low, nearly as low as the likelihood of reducing ambulance idling. Police and first responders may view shutting off their vehicles as a safety concern, and therefore would be unlikely to adopt idle reduction technologies. Similarly, participants considered the likelihood of reducing personal vehicle idling as very low because Clean Cities coalitions typically engage fleets, not individuals.

Attendees emphasized the opportunity for Clean Cities coalitions to spread information about the potential cost savings that fleet operators could achieve through idle reduction. Many fleet operators are not aware of the magnitude of emissions reductions and costs savings that idle reduction could deliver. Reducing idling, however, provides an easy and immediate return on investment for all vehicle owners, provided that driver behavior changes. Participants suggested that using technology and enforcing local idling regulations will help change driver behavior, resulting in cost savings for fleet owners and reduced petroleum use. For instance, reducing default idle times for buses, trucks, and other fleet vehicles from 15 to 5 minutes could be a simple and effective method of reducing idling.

Participants noted that personal vehicles may present an enormous opportunity to reduce idling, but the amount that each vehicle idles is relatively small. Since Clean Cities coalitions do not typically engage individuals, as noted above, DOE Clean Cities should leverage other means to reach a large number of individual drivers. Idle reduction from personal vehicles may require behavior change, which attendees felt DOE Clean Cities could encourage by sharing information. Promoting existing idle reduction information in fuel economy programs, such as driving tips on the fuelconomy.gov website, would expand the audience for idle reduction information sharing. In areas with

lines of idling vehicles, such as schools or drawbridges, attendees suggested that local Clean Cities coalitions could promote signage that discourages idling. DOE Clean Cities could also work with automakers to install automotive idling reduction technologies, such as automatic start-stop systems, that would not rely on driver behavior change.

Idle Reduction Top Market Opportunity: Diesel APUs for Northern Long Haul Truck Routes and Electrified Parking Spaces for Southern Long Haul Truck Routes

Argonne National Laboratory estimates there are approximately 1 million long haul trucks with sleeper cabs. According to a study by the Carbon War Room and the North American Council for Freight Efficiency, idle times ranged from 7 to 40 percent, with an average of 15 percent. APUs may reduce idling by providing heat for drivers while sleeping in their trucks in cold climates. Along northern routes, diesel APUs often are preferred to battery APUs in these cases, because the diesel APUs are more efficient at delivering heat and weigh less, which provides fuel economy benefits. Along southern routes, APUs may not provide adequate power to provide air conditioning for drivers who sleep in their trucks. In these cases, electrified parking spaces enable trucks drivers to draw power, which allows drivers to reduce idling.

Attendees considered both the northern and southern long haul truck routes to have a high potential, both overall and for each of the individual categories. The use of diesel APUs along northern routes was considered to have a slightly higher overall potential than the use of electrified parking spaces along southern routes, but both types were considered to have the same moderate potential for DOE Clean Cities and local coalitions to make an impact. While the long haul truck market opportunities have the biggest “bang for the buck” of all idle reduction opportunities, participants also noted that they might be the hardest vehicles for DOE Clean Cities and local coalitions to directly influence.

In terms of likelihood, attendees considered that APUs may be easier to implement than electrified parking spaces because of their lower cost, and because drivers do not need to change their behavior when using APUs. Coalitions could engage fleet managers to install the diesel APUs, requiring little or no effort from the long-haul drivers. Because electrified parking spaces require a change in behavior, encouraging drivers to use this idle reduction technology may be more difficult. DOE Clean Cities could work with large fleet operators to promote the availability and locations of electrified parking spots in areas that are in non-attainment of the Clean Air Act.

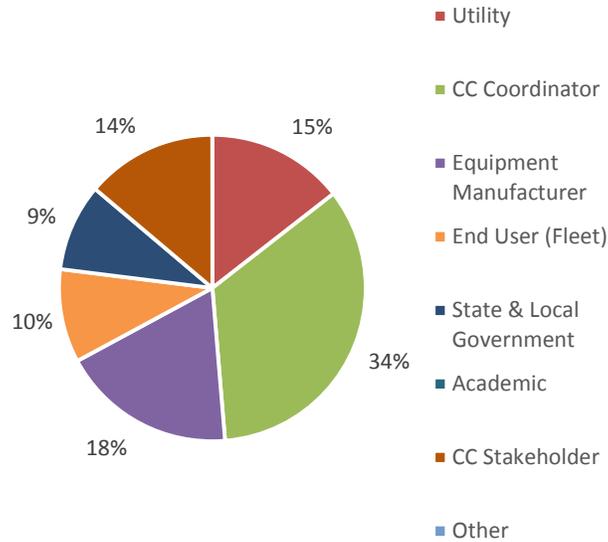
Participants suggested that DOE Clean Cities should educate fleets about cost savings through greater use of idle reduction technologies. Notably, long haul trucks are not eligible for EPA grant funding through the Diesel Emissions Reduction Act because they do not deliver local emissions reductions.

Attendees also made the following suggestions:

- **Regional haul vehicles, including port and delivery fleet vehicles, could benefit from idle reduction technologies.** Clean Cities coalitions could work with these fleet operators more easily than long-haul fleet operators.
- **Clean Cities coalitions could help idle reduction projects target funding sources and discern how funding can be applied to projects.** Funding from the Diesel Emissions Reduction Act may be applied to reducing school bus fleet idling, for instance, but would not apply to private long-haul trucking idling reductions or to meet local emissions regulations. Funding programs from state agencies, such as the California Air Resources Board, may be applicable to idle reduction projects.
- **Clean Cities coalitions could engage local utilities about the cost savings of APUs and other idling reduction technologies and techniques.** Utility service technician vans often idle between customer visits, and bucket trucks idle while performing repairs or installations. The amount of idling may be increased during times of distress, such as after major weather events.

- Clean Cities coalitions could engage school boards about reducing school bus idling, which may be seen as a health concern for students.

Figure 6: Idle Reduction Participants by Affiliation (16 Attendees)



This figure shows the self-identified affiliation of each participant in the idle reduction breakout group.

Conclusion

The strategy session successfully gathered stakeholder feedback on DOE Clean Cities' potential to reduce petroleum use through the application of dozens of strategies. Some opportunities to reduce petroleum use were unique to each alternative fuel or reduction strategy, while others, such as regional haul, school buses, and paratransit vehicles, were considered in several breakout groups. Petroleum use reduction strategies also cut across market opportunities in some instances; establishing stations that support multiple fuel types could help increase station use and lower costs. Attendees agreed to the recommendation from the laboratory experts to combine idle reduction with alternative fuels to produce the greatest petroleum use reductions possible.

The diversity of Clean Cities coalitions and the regions they serve also influences which petroleum use reduction strategies are optimal. The petroleum use reduction priorities of individual coalitions may be affected by the local climate, geography, or stakeholder composition. EV strategies may be most effective in regions that have more developed public charging infrastructure. Engaging with port operators to switch their vehicles to natural gas, propane, or biodiesel would depend upon coalitions' access to shipping or freight hubs.

The differences in market conditions between DOE Clean Cities' 2009 Strategic Plan workshop and the 2015 Strategic Plan workshop highlight the complexity and frequent technological and policy shifts in the AFV market. For example, since the formulation of the program's previous Strategic Plan:

The PEV market has risen from non-existence to a considerable AFV market. In 2009, EVs were not yet introduced to the mass market. At the time of the 2015 strategic planning meeting, more than 300,000 PEVs had been sold. Public electric charging infrastructure has sprouted along travel corridors and in dense urban areas, partly on account of sizeable government investments in alternative fuels through funding authorized by the American Recovery and Reinvestment Act, the economic stimulus package of 2009. The growth of the EV market has encouraged some Clean Cities coalitions to shift their engagement practices by focusing some of their outreach efforts on consumers instead of fleets.

A rapid expansion of domestic natural gas production recently reduced CNG prices and gave CNG fuel prices a competitive advantage over gasoline and diesel prices. An even more recent decline in petroleum prices that began in 2014, however, has reduced CNG's price competitiveness. While the decline in petroleum prices has adversely affected the total cost of ownership of an NGV, the U.S. Energy Information Administration has forecasted that natural gas can be competitive with petroleum as a vehicle fuel, and that this situation will exist for many years.

Comprehensive climate policies gained momentum at a regional and national level. In 2009, eleven Northeast governors signed a Memorandum of Understanding to evaluate a regional low-carbon fuel standard (LCFS), which is a policy to reduce the carbon content of transportation fuels. At a national level, the U.S. Congress was considering comprehensive cap-and-trade bills that would limit greenhouse gas emissions across all sectors of the United States. Currently, California is the only state with an LCFS, though Oregon is moving forward with implementation of its LCFS program. In addition, the U.S. Congress is not actively considering a national climate policy, though the EPA is using its regulatory authority to reduce greenhouse gas emissions through national vehicle and power plant standards.

DOE Clean Cities and its coalitions will benefit from remaining flexible and adaptive in order to continue to identify the most promising opportunities to reduce petroleum use. The advancement of new technologies and the evolution of vehicle and fuel markets could alter the promise that each strategy offers to reduce petroleum consumption. DOE Clean Cities and local coalitions may work to ensure that the best petroleum use reduction strategies are applied situationally. As the presentations at the meeting's outset suggested, reducing petroleum use will be difficult, particularly in a period of low gasoline prices, but DOE Clean Cities can make an impact by remaining attentive to changing conditions as it deploys its suite of petroleum use reduction strategies. Regularly convening stakeholders and recording feedback, such as Strategy Planning meetings provide, will help DOE Clean Cities capitalize on its strengths, reduce deployment barriers, and adapt to new technologies and market conditions.

Appendix A: Meeting Agenda

A stakeholder meeting to help inform the 5-year strategic plan of the Clean Cities Program

February 25, 2015
9:00 a.m. – 4:00 p.m.
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC

9:00 a.m. **Welcome and Introductions – Large Auditorium (GE-086)**
Pat Davis, Dennis Smith, and Linda Bluestein, U.S. Department of Energy
Marcy Rood Werpy, Argonne National Laboratory
Dr. David Greene, University of Tennessee

U.S. DOE will welcome the audience and provide brief introductory remarks.

Marcy Rood Werpy will introduce the structure of the event and provide context for Dr. Greene's presentation.

Dr. David Greene will provide a short presentation on the effect of the recent drop in gas prices on alternative fuel vehicles (AFVs), with time for a short Q&A session.

9:20 a.m. **Plenary: Markets and Opportunities for AFVs Part 1 – Large Auditorium (GE-086)**
Dennis Smith and Linda Bluestein, U.S. DOE
National Lab Presenters

U.S. DOE will present market and technology research collected from national laboratories on several alternative fuels. Market research may include trends in fuel prices and vehicle sales, while technologies may include material or process improvements or emissions updates. Each presentation will focus on new research for each alternative fuel, with a pre-determined time limit allotted for each fuel type. Fifteen minutes will be reserved for Q&A. The presentations will focus on the following fuel types:

- Natural Gas: Andy Burnham and Marianne Mintz, Argonne National Laboratory (15 minutes)
- Biofuels: Caley Johnson and Wendy Dafoe, National Renewable Energy Laboratory (15 minutes)
- Propane: Margo Melendez, National Renewable Energy Laboratory (15 minutes)

DOE will also introduce its focus on market opportunities, emphasizing opportunities for each AFV type to make incremental inroads to public and consumer acceptance. Participants will be encouraged to consider the role of market opportunities during subsequent breakout groups.

10:20 a.m. *Break*

10:30 a.m. **Plenary: Markets and Opportunities for Advanced Technology Vehicles and Petroleum Use Reduction Practices**
Part 2 – Large Auditorium (GE-086)
Dennis Smith and Linda Bluestein, U.S. DOE
National Lab Presenters

This is a continuation of the 9:20 a.m. session. Each presentation will focus on new research for each advanced technology vehicle or petroleum use reduction practices, with a pre-determined time limit allotted for each. Fifteen minutes will be reserved for Q&A. The presentations will focus on the following areas:

- Consumer Fuel Economy: Bo Saulsbury, Oak Ridge National Laboratory (15 minutes)
- Plug-in Electric Vehicles and Hybrid Electric Vehicles: Dr. Dan Santini, Argonne National Laboratory (15 minutes)
- Idle Reduction: Dr. Linda Gaines, Argonne National Laboratory (15 minutes)

DOE will continue to introduce its focus on market opportunities, emphasizing opportunities for each advanced vehicle technology or petroleum use reduction practices to make incremental inroads to public and consumer acceptance. Participants are encouraged to consider the role of market opportunities during subsequent breakout groups.

11:30 a.m. **Lunch**

12:30 p.m. **Breakout A: Natural Gas – Large Auditorium (GE-086)**
Breakout B: Biofuels – Small Auditorium (GJ-015)
Breakout C: Consumer Fuel Economy – Room 1E-245

1:50 p.m. *Break*

2:00 p.m. **Breakout D: Plug-In Electric Vehicles & Hybrid Electric Vehicles – Large Auditorium (GE-086)**
Breakout E: Propane – Small Auditorium (GJ-015)
Breakout F: Idle Reduction – Room 1E-245

3:20 p.m. **Summary, Discussion and Next Steps – Large Auditorium (GE-086)**
Dennis Smith and Linda Bluestein, U.S. DOE

DOE will summarize key takeaways from the day, highlighting prominent market opportunities identified by breakout groups. Participants are encouraged to share their own observations. DOE will also discuss possible next steps.

4:00 p.m. **Adjourn**

This event has been made a success due to the hard work of the planning team, facilitators, and the experts from the National Laboratories. Planning Committee and facilitators included representatives of U.S. DOE Clean Cities, Argonne National Laboratory, Center for Climate and Energy Solutions, Energetics, Institute for Conservation Leadership, New West Technologies, Public Solutions, and Sustainable Energy Strategies.

Appendix B: Workshop Proceedings

Welcome and Introductions – Large Auditorium (GE-086)

Speaker: Pat Davis

- Your input helps us identify the primary focus for the Clean Cities Program 5-year plan.
- The market enjoys the status quo, breaking the cycle is difficult. Market may not buy the product even if the research and development arm of DOE does its job and lowers the cost of vehicle technology.
- Low oil prices mask the true cost of consuming oil.
 - Petroleum dependency
 - Energy independence
 - Climate change
- The Clean Cities Program has a national reach and a local focus.
 - The Clean Cities program is an indispensable part of efforts to reduce petroleum consumption, with more than 2.2 billion gallons of petroleum displaced.
- Clean Cities Coalitions are experts at connecting the right people for all alternative fuels.
 - This group of stakeholders understands the difficulty of deploying alternative fuels.

Speaker: Dennis Smith

- The staff at DOE will be in listening mode today.
- So much has changed since the Clean Cities Program began twenty years ago such as the introduction of hybrid electric vehicle technology and the rise of social media.
- The 5-year meeting keeps the program plugged in to what is going on in the industry.
- Please try to keep your recommendations to within the scope of the program's responsibilities and capacity.
- The budget for Clean Cities has been mostly flat for the last 8 years, illustrating that it retains bi-partisan support.

Speaker: Linda Bluestein

- There are no wrong ideas.
- The input from you all today informs DOE about how we should prioritize the use of our resources.

Speaker: Marcy Rood Werpy

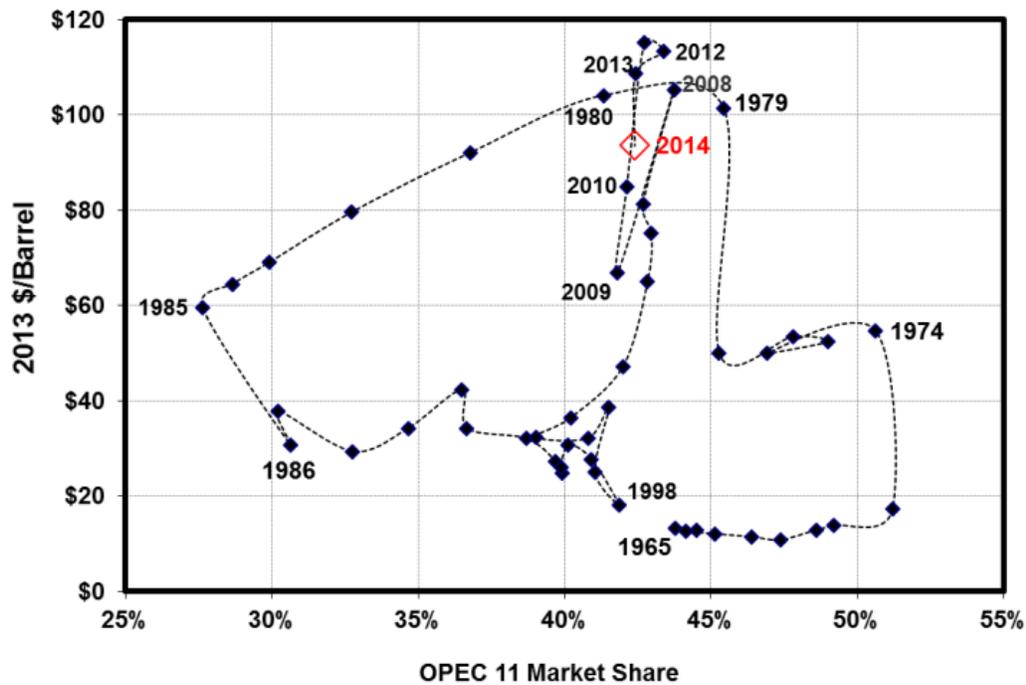
- We are on our way to meeting our program goal of displacing 2.5 billion gallons of petroleum per year by 2020. We must stay focused.
- There are two broad questions we're asking today:
 - What are the target markets that provide the greatest opportunity to advance AFVs, ATVs, and Petroleum Use Reduction Practices?
 - How should these strategies be accomplished?
- We have several key dates coming up:
 - Draft Document Due: May 15, 2015
 - Coordinator Council Presentation: June meeting
 - Final Document Due: August 15, 2015
 - Webinar to Clean Cities Network: September (TBD)
- We should expect further price volatility and rising petroleum prices

- When comparing alternate fuel prices, we should compare those prices to a broad range of petroleum prices

Speaker: David Greene

- Materials: [Presentation Link](#)
- Why did oil prices crash recently and what can we do about it?
- The crash following the 2008 price spike to \$140/barrel is very similar to the 2014 crash, in terms of the steepness of the price decline.
- The cost of a gallon of gasoline depends on transportation costs, refining costs, federal taxes, local taxes, etc.
 - The cost of everything but the crude oil has been more or less \$1.10 over the past 40 years.
 - Only the crude oil price changes.

OPEC Market Share and World Oil Prices: 1965-2013



- It was very unusual for oil prices to stay around \$100/barrel from 2010-2014, and that indicates a fundamental change in the oil market.
- OPEC has been able to fix the price at approximately \$100 without reducing demand because of the inability for consumers to substitute oil product for other products (known as demand inelasticity).
- Prices will not remain either very high or very low because of the inelasticity of demand for oil. There will continue to be volatility.
- Shale production in the United States has reduced oil imports, but price volatility will continue.

Plenary: Markets and Opportunities for AFVs Part 1 – Large Auditorium (GE-086)

Natural Gas Vehicle Technology Market Trends by Andrew Burnham and Marianne Mintz of Argonne National Laboratory

- Materials
 - [Presentation Link](#)
 - [Briefing Paper Link](#)
- Natural gas accounts for approximately 60 percent of current petroleum displacement by alternative fuels. Fifty-eight percent of displacement comes from CNG.
- Approximately 120-150,000 natural gas vehicles are on the road today.
 - About 70,000 of these vehicles are light-duty.
 - Sales of natural gas vehicles are flat, but fuel use is growing—about 80 percent of fuel use comes from heavy-duty vehicles.
- Current market opportunity: natural gas vehicles may constitute up to 50 percent of new sales for refuse trucks and 25 percent of new sales for transit buses.
- Navigant and other research firms predict increasing natural gas vehicle sales due to low natural gas prices.
- The five market opportunities identified for natural gas vehicles are:
 - Regional Haul
 - Concrete Mixers
 - Paratransit/Shuttles
 - School Buses
 - Utility Service Vehicles
- The most immediate market opportunity among all opportunities is regional haul, which has a payback period of only 1-3 years.
- Renewable natural gas offers some reduction in fuel price, but its primary contribution is in terms of reducing greenhouse gas (GHG) emissions
 - Recovering landfill gas is the largest renewable natural gas opportunity. There are 636 operational landfill projects in the United States, but only about 5 percent of them (37 projects) currently produce transportation-grade natural gas.
 - Food waste offers the next largest RNG opportunity, which is more concentrated in urban areas. Wastewater treatment facilities and farms offer the greatest gas recovery opportunity.
- RNG production is starting to earn Renewable Identification Numbers for the federal Renewable Fuel Standard,⁶ which will help reduce production costs.
 - Nearly all cellulosic ethanol renewable identification numbers (RINs) come from RNG.
- Regarding barriers, RNG must compete with composting, which can be done at a much lower cost.

E85 by Caley Johnson of National Renewable Energy Laboratory

- Materials

⁶ The Renewable Fuel Standard (RFS) is a requirement that a certain percentage of petroleum transportation fuels be displaced by renewable fuels. RFS is for biofuels only and requires obligated parties to sell a certain amount of biofuels per year through 2022. RFS contains a four-part mandate for lifecycle greenhouse gas emissions levels relative to a 2005 baseline of petroleum: for renewable fuel, advanced biofuel, biomass-based diesel, and cellulosic biofuel. In order to track renewable fuel sold into the market, the EPA requires renewable fuel producers and importers to assign unique Renewable Identification Numbers for each batch of renewable fuel sold where a batch is any amount less than 100 million gallons per month, unless the producer or importer processes less than 10,000 gallons per year. Source: <http://www.c2es.org/federal/executive/renewable-fuel-standard>

- [Presentation Link](#)
- [Briefing Paper Link](#)
- Clean Cities has produced an ethanol handbook, which is one of the most downloaded documents off the Alternative Fuels Data Center website.
- The National Renewable Energy Laboratory has performed case studies to highlight best practices in fleet management and fuel distribution.
 - Chicago requires E85 to be used in flex fuel vehicles (FFVs) for fleets.
 - Interstate 65 corridor for E85 (about 800 miles)
- 16.5 million mostly light-duty vehicles on the road are capable of using an 85 percent ethanol blend.
 - Nearly 3,000 stations across 47 states and DC offer E85. Infrastructure is largely accessible to the public.
- New policies have begun to affect the use of E85 and flex fuel vehicles.
 - By 2020, corporate average fuel economy (CAFE) standards require that vehicle drivers use E85 before auto manufacturers get credit for alternate fuel use.
 - Energy Policy Act of 2005 (EPA Act) requirements will increase fleet alternative fuel vehicle deployment.
 - The Renewable Fuel Standard's "blend wall" of E10 or E15 could encourage the increased use of E85.⁷
- Research shows that E85 dispensers are extremely underutilized—the development of strategies to improve performance could be a priority. These strategies could include:
 - Educating drivers on FFV technology, E85 availability, and E85 sustainability. Improved messaging would help most with informing the public about ethanol sustainability.
 - Improving upon the alternative fuel "inconvenience cost" by increasing station availability to up to 20 percent of all gas stations.
- One of the most important E85 opportunities is getting the millions of FFVs on the roads to use E85, particularly at existing fueling stations.

Biodiesel by Wendy Dafoe of National Renewable Energy Laboratory

- Materials
 - [Presentation Link](#)
 - [Briefing Paper Link](#)
- Biodiesel handling and use guidelines are also one of the most downloaded documents off the AFDC website.
- 13 million predominantly medium- and heavy-duty diesel vehicles are on the roads today, though light-duty models and vehicles sales are increasing.
- 775 U.S. stations currently sell B20 or higher biodiesel blends, though only 285 of those stations are public.
- Market opportunity findings show that biodiesel has low barriers to entry, particularly because it is a drop-in fuel that can be used now for any diesel-fueled vehicle.
- Several target opportunities have been identified, the most prominent of which are all heavy-duty vehicle fleets.
 - School bus fleets are a promising opportunity that could benefit from the use of B20 or higher biodiesel blends.
 - Work trucks and drayage vehicles are another similar, promising opportunity for biodiesel.

⁷ Almost all gasoline sold in the United States contains up to 10 percent ethanol (E10). While renewable fuel production has grown, economic factors including improved vehicle fuel economy have resulted in less gasoline consumption than what the U.S. Congress expected when it updated the Renewable Fuel Standard in 2007. This is known as the "blend wall." Source: <http://www.epa.gov/oms/fuels/renewablefuels/documents/420f13048.pdf>

- The total number of drayage vehicles in use is not entirely known, but they are older and provide a terrific opportunity as a drop-in fuel.
- Assuring fuel quality and providing guidance for new users is essential.

Propane by Margo Melendez of National Renewable Energy Laboratory

- Materials
 - [Presentation Link](#)
 - [Briefing Paper Link](#)
- Clean Cities is currently engaged with standardization of propane vehicle fueling infrastructure.
 - Currently lacking fueling standards and pricing consistency
- There are currently 140,000 propane-propelled vehicles on U.S. roads, which are predominantly light-and medium-duty vehicles.
 - There are almost 3,000 stations available to fuel these propane vehicles, though only about half of these stations are designated by the AFDC as “primary for autogas” (i.e., they operate like a typical gas station).
- Today’s largest propane vehicle opportunities are school buses (2 percent are LPG) and delivery trucks.
- Propane vehicle market opportunities to explore include:
 - School buses: Propane provides consistent performance in cold weather, and the nation’s 650,000 school buses present a large fleet opportunity.
 - Paratransit Shuttles: These vehicles are currently using almost no alternative fuels, so they present a great opportunity for growth.
 - Delivery Vehicles: The large number of fleets and vehicles on the road could use propane.
 - Government fleets: The government controls a fleet of nearly 4 million vehicles, which will meet with increasingly stringent AFV requirements.
- Coordination among industry and propane suppliers is very important for the advancement of propane as a transportation fuel. Most notable, the user experience must be improved, streamlined, and standardized (e.g., a common dispenser nozzle).

Light-Duty Vehicle Fuel Economy by Bo Saulsbury of Oak Ridge National Laboratory

- Materials
 - [Presentation Link](#)
 - [Briefing Paper Link](#)
- FuelEconomy.gov site has eclipsed the online Fuel Economy Guide as the most popular consumer tool for consumer fuel economy: the website hosted about 58 million user sessions in 2013.
- Research at Oak Ridge National Laboratory promotes fuel-efficient driving and vehicle maintenance tips to consumers.
- Fuel economy has been improving in recent years, with light-duty vehicle economy increasing by about 25% since 2005.
 - Increasingly strict CAFE standards will likely improve fuel economy in the coming years.
- Target fuel economy opportunity include:
 - Development of a “Fuel Economy Toolkit,” which would incorporate existing tools from fueleconomy.gov and the AFDC website, for use by Clean Cities coordinators.

- The toolkit would also be available for general consumer use.
- May lend itself to an Ad Council-type campaign to raise awareness about the importance of fuel economy.
- The used vehicle market is much larger than the new vehicle market, but does not have rigorous information standards, such as requiring EPA stickers with mile per gallon information.
 - Coordinators could reach out to used car dealers and websites to use fueleconomy.gov MPG stickers on used vehicles.
- Consumer uncertainty about the EPA’s MPG estimates could be reduced with a “personalized MPG Calculator” that would use on-board diagnostics to develop an accurate, individualized fuel economy report.
- Website functionality must adapt to new consumer uses, which increasingly accesses fueleconomy.gov through mobile devices.
- Development of a strategy for periods of low gasoline prices, such as demonstrating “expected” fuel prices on EPA stickers, will help focus consumers on the importance of fuel economy.
- Developing strategies for Advanced Technology Vehicles
 - Each fuel technology requires different MPG measurements. Researching MPG, and maintenance and driving tips, will become increasingly important as AFV deployment increases.

Electric Drive Technology Market Trends by Dan Santini of Argonne National Laboratory

- Materials
 - [Presentation Link](#)
 - [Briefing Paper Link](#)
- DOE issued 16 Plug-In Electric Vehicle Readiness Grants that created regional PEV Readiness Guides. These guides are intended to frame a region’s PEV challenges and opportunities and to provide guidance to other Clean Cities coalitions.
- Nearly all hybrid electric vehicle (HEV) growth has come in the light-duty vehicle market. Heavy-duty HEVs were brought to market, but have not succeeded.
- PEVs show a wider range of light-duty body types than HEVs, such as the Tesla Model S and BMW i8 luxury PEV models.
 - Because there are still only a limited number of PEV models, the sales of each model can greatly impact the PEV market’s sales by body type (e.g., compact and midsize). A large, diverse number of HEVs are now available, so the sales of one model will have a smaller effect on the HEV market’s sales by body type.
- The switch from Nickel Hydride to lithium ion batteries helped precipitate the growth of PEVs.
 - The takeoff rate (rate of early-stage growth) of PEVs has exceeded the takeoff rate of HEVs.
- The range of electric vehicles can be complex, with approximately a dozen variants with unique acronyms. The simplest terms typically consist of Hybrid Electric Vehicle (HEV), Plug-In Hybrid Electric Vehicle (PHEV), and Battery Electric Vehicle (BEV) or all-electric vehicle.
- Climate can potentially impact PEV markets, and in particular may reduce BEV market shares.
 - A mild climate might improve the prospects of a BEV market. California, Georgia, Washington, Oregon, and Hawaii are all comparatively successful BEV markets that enjoy typically mild climates.

- PEV market opportunity markets that Clean Cities may pursue include:
 - Dense, urban areas with high vehicle use rates (hours/day and days/year).
 - Workplace charging gives employees a definite location to charge their vehicles. Notably, PHEVs benefit the most for electric VMT through workplace charging.
 - Cold climate areas and areas with extreme heat (above 100 degrees).
 - BEV range can be reduced by 40-50%. PHEVs are effective in these areas, since gasoline engines are important as backups.
 - Non-attainment areas, in which approximately one third of the U.S. population lives.
 - New construction at metro edges.
 - HEV passenger cars nationwide, particularly in cities.

Idling Reduction Opportunities by Linda Gaines and Patricia Weikersheimer of Argonne National Laboratory

- Materials
 - [Presentation Link](#)
 - [Briefing Paper Link](#)
- Over 3 billion gallons of gasoline-equivalent is wasted each year on idling.
- Every vehicle idles, but only some idling is necessary.
 - Personal vehicle idle reduction is not considered as a market opportunity for Clean Cities to pursue, but the potential for idling reduction is tremendous due to the number of personal vehicles on the road. A few ideas to keep in mind about personal vehicle idling:
 - Idling beyond 10 seconds uses more fuel than it takes to restart a car.
 - Media information about personal idling is often incorrect.
- The upfront expense of installing idling reduction equipment will be offset by fuel savings.
- Reducing misinformation and producing standard information led to the development of an idling reduction toolkit called [IdleBox](#).
- Market opportunities for idle reduction include:
 - School buses
 - Automatic heaters to warm buses can reduce labor and capital costs that are spent on fuel and staff arriving early to start vehicles.
 - One major barrier for cold weather school bus idling reductions with heaters is that heaters are only necessary in cold weather areas, during school days in the winter, for approximately 3-4 hours per day.
 - Bucket trucks
 - Plug-in hybrids could save fuel by reducing idling.
 - These trucks are driven only a minimal amount, but spend lots of time idling.
 - Police cars and Ambulances
 - Police cars are idling 60 percent of the time.
 - Battery Auxiliary Power Units (APUs) can recharge while driving and power vehicle appliances while parked, reducing idle times.
 - Long-haul trucks
 - These trucks represent a large opportunity to reduce idling that Clean Cities coalitions don't often engage with.

- Diesel APUs make sense for drivers along northern routes in the United States.
 - Diesel APUs are preferable over battery APUs because diesel APUs have the advantage of being able to run for as long as needed, anywhere. Battery APUs are limited to 8-10 hours of operation, unless they have access to someplace to plug in. The hours-of-service regulations force a 34-hour rest basically once a week, which the battery APU cannot handle at most locations. If it is very hot, the battery power is used up faster, and the unit may not even be able to keep the sleeper cool for 8 hours.
 - Battery APUs are preferable when only 10-12 hours of power is needed at a single stretch.
- Because Diesel APUs may not provide adequate power for air conditioning, an Electrified Parking Space system would be recommended along southern routes.

Summary, Discussion and Next Steps – Large Auditorium (GE-086)

Wrap-Up by Linda Bluestein

- Thank you to the partner organizations and the participants for making the meeting a success.



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